



Conserve O Gram

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Ethylene Oxide Health And Safety Update

Background

Ethylene oxide (chemical formula C_2H_4O) is a fumigant fungicide and insecticide that has been used to sterilize hospital instruments, fumigate some imported foods, and in museums, to fumigate books and archival materials, furs, textiles and furniture. In recent years, ethylene oxide (EtO) safety standards have grown increasingly more restricted and many museums have cut back or suspended its use. Increasing awareness of associated health risks resulted in the current strict standards for use established by the Occupational Safety and Health Administration (OSHA) in June 1984. These are available in 29 CFR 1910.1047, which became effective in 1985. This standard applies to all institutions using the chemical as a fumigant and to all persons handling objects that have been fumigated with EtO, thus covering all on-site and contract fumigation.

The two primary sources of exposure to EtO are the operation of a fumigation chamber and the release of residual fumigant from treated objects. EtO can be entrapped in museum objects, especially those materials with a high fat content (e.g., leather), and in containers (e.g., document boxes, cardboard tubes). Objects and containers can continue to emit gaseous EtO for a considerable length of time following treatment. Thus, while monitored levels may be within an acceptable range following fumigation and aeration, the levels may gradually rise again, particularly in storage areas and when objects are enclosed. Park staff must insure that all materials fumigated on-site or on contract are properly aerated, and must then continue to monitor and record EtO levels near fumigated objects and within closed containers.

The OSHA standard covers monitoring and recordkeeping for staff exposure, designating and controlling access to areas of use, engineering requirements for chambers, establishing safe work practices, establishing a written compliance program if exposures are above the permissible exposure level, use of appropriate respirators and personal protective equipment, medical surveillance programs, and communication of EtO hazards to staff.

Properties

- **Colorless** in liquid and gaseous state.
- **Detectable by an ether-like odor** at approximately 700 parts per million parts of air @pm).
- **In pure state**, highly toxic, flammable, explosive, with flash point less than 0°F; decomposes violently at temperatures above 800°F. **In use as a fumigant**, EtO is mixed with an inert gas such as carbon dioxide to eliminate the flammability hazard.

Synonyms

EtO; dihydrooxirene; dimethylene oxide; EO; 1,2-epoxyethane; epoxyethane; oxacyclopropane; oxane; oxidoethane; alpha/beta-oxidoethane; oxiran; oxirane.

Health Related Effects^{1,2}

- **Route of Entry:** Skin contact, inhalation, ingestion.

- **Organs Affected:** Liver, blood, digestive system, respiratory system, reproductive system, peripheral nervous system, skin and eyes.
- **Acute Effects (short-term):** Respiratory irritation and lung injury (including bronchitis and chemical pneumonia), headaches, nausea, vomiting, diarrhea, shortness of breath, cyanosis (blue or purple coloring of the skin).
- **Chronic Effects (long-term):** Headaches, burning eyes, swelling of eyelids, nausea, drowsiness, fatigue, chest pain, sinus congestion, peripheral neuropathy, dermatitis of exposed areas of head, neck, and hands; may cause allergies in susceptible persons.
- **Carcinogenic Effects:** Has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans.
- **Reproductive Effects:** Can cause chromosomal damage and adverse reproductive effects.

OSHA Standard"

Permissible Exposure Limit (PEL): **1 part Et0 per million parts of air (1 ppm) as an 8-hour time-weighted average (8-hour TWA) over an 8-hour day.**

Short-term Exposure Limit (STEL): **10 ppm averaged over a 15-minute period.**

NOTE: The OSHA standard establishes an action level of 1/2 ppm. If this level is exceeded, the standards of 29 CFR 1910.1047 become effective.

Effectiveness

Et0 is to be used as a fumigant only in a chamber, and not as a contact pesticide or

deterrent. It is not effective in killing insect eggs unless used in a vacuum.

Reactivity to Museum Objects

There is evidence that this chemical can soften glues, react with protein material to cause deterioration, and react with cellulose and salt causing permanent alterations. More research on the effects of this fumigant on museum objects is needed.

Environmental Protection Agency Restrictions

It is a violation of the federal Insecticide, Fungicide, and Rodenticide Act of 1972, as amended, to use a biocide inconsistently with its labeling. Books and archival materials are among the materials for which the use of Et0 is currently not approved. See Et0 labeling for permissible uses.

Conclusion

National Park Service units must not use ethylene oxide on museum objects unless an alternative solution cannot be found. The permissible exposure limit of one part per million clearly indicates the extreme toxicity of this chemical. Meeting the required standards in equipment use, monitoring, and long-term medical surveillance is both costly and labor-intensive.

Any park or center considering Et0 fumigation either on-site or on contract must obtain approval from the WASO Integrated Pest Management (IPM) Coordinator via the Regional Curator and the Regional IPM Coordinator, before obtaining the chemical or issuing the contract. **In accordance with EPA restrictions, Et0 will not be approved for fumigating books and archival materials.** Parks and centers

must strictly adhere to all standards of 29 CFR 1910.1047.

For on-site fumigation, all the engineering controls and prescribed work practices must be in full compliance with the OSHA standard. For contract fumigation, parks and centers must ensure that treated materials have been adequately aerated to reduce outgassing of residual EtO. Contractors must conduct air sampling, and it is recommended that parks and centers require them to furnish, in writing, adequate information about the amount of aeration provided and air sample readings taken. Parks and centers must prominently mark the exterior of all storage cabinets that contain objects treated with EtO, and must also obtain data sheets on monitoring devices and on controlling exposure to EtO. These sheets are available from the Center for Safety in the Arts, 5 Beekman Street, New York, NY 10038, (2 12) 227-6220.

Notes

1. **Code of Federal Regulations**, Title 29, Chapter XVII, Appendix A (7/1/91 edition), p. 302.
2. Perri Peltz and Monona Rossol, **Safe Pest Control Procedures for Museum Collections** (New York: Center for Occupational Hazards [now the Center for Safety in the Arts], 1983).
3. **Code of Federal Regulations**, Title 29, Chapter XVII (7/1/91 edition), p. 295.

Reference

Knapp, Anthony M. "Curatorial Health and Safety Issues," NPS **Museum Handbook**, Part I, Chapter 11. Washington, D.C.: National Park Service, 1990.

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